OBSERVATIONS & RECOMMENDATIONS

Following is a summary of the current year and historical data collected at each of the **LAKE SUNAPEE NEARSHORE STATIONS**.

NEARSHORE STATION SUMMARY (OVERALL STATION SUMMARY):

CHLOROPHYLL-A
Figure 1 and Table 1:

- The graphs in Figure 1 (Appendix E) show the historical and current year chlorophyll-a concentration in the water column. Table 1 (Appendix F) lists the maximum, minimum, and mean concentration for each sampling season that the lake has been monitored through the program.

  Chlorophyll-a, a pigment found in plants, is an indicator of the algal abundance. Because algae are usually microscopic plants that contain chlorophyll-a, and are naturally found in lake ecosystems, the chlorophyll-a concentration measured in the water gives an estimation of the algal concentration or lake productivity. **The median (average) summer chlorophyll-a concentration for New Hampshire's lakes and ponds is 4.58 mg/m^3.**

Lake Sunapee Nearshore Station Chlorophyll-a Data

Stn.	2007 Range (min – max) (mg/m^3)	2007 Mean Value (mg/m^3)	Annual Mean Range for all sampling years (mg/m^3)	Comments
010	0.95 – 2.93	2.10	0.80 – 3.69	Statistical analysis of historic data shows no overall increase or decrease in the mean annual concentration since monitoring began. Visual observation shows a slightly variable mean annual concentration that has been steadily increasing (worsening) since 2003. Current year trend shows an increase from June to July, and a decrease from September to October.
020	0.76 – 1.80	1.29	1.10 – 3.00	Statistical analysis of historical data shows no overall increase or decrease in the mean annual concentration since monitoring began. Visual observation shows a slightly decreasing (improving) mean annual concentration. Current year trend shows an increase from June to July, and a decrease from July to October.

Stn.	2007 Range (min – max) (mg/m^3)	2007 Mean Value (mg/m^3)	Annual Mean Range for all sampling years (mg/m^3)	Comments
030	0.19- 2.68	1.76	0.70 – 3.35	Statistical analysis of historic data shows no overall increase or decrease in the mean annual concentration since monitoring began. Visual observation shows a slightly increasing (worsening) mean annual concentration. Current year trend shows an increase from June to September, and then a sharp decrease from September to October.
060	1.11 – 2.35	1.67	0.63 – 4.39	Statistical analysis of the historic data shows no overall increase or decrease in the mean annual concentration since monitoring began. Visual observation shows a decreasing (improving) trend. Current year trend shows an increase from June to September.
070	0.76 – 3.25	2.12	0.71 – 3.74	Statistical analysis of historic data shows no overall increase or decrease in the mean annual concentration since monitoring began. Visual observation shows a slightly variable mean annual concentration that has been increasing (worsening) since 2003. Current year trend shows an overall increase from June to September, and a sharp decrease from September to October.
080	1.09 – 2.51	1.90	0.84 – 2.92	Statistical analysis of the historic data shows no overall increase or decrease in the mean annual concentration since monitoring began. Visual observation shows a slightly variable mean annual concentration that has been increasing (worsening) since 2003. Current year trend shows an increase from June to August, and a slight decrease from August to September.
090	1.28 – 2.35	1.73	0.78 – 2.85	Statistical analysis of historic data shows no overall increase or decrease in the mean annual concentration since monitoring began. Visual observation shows a slightly variable mean annual concentration that has been increasing since 2002. Current year trend shows an overall increase from June to September.
100.1	0.76 – 3.06*	1.54**	1.39 – 1.54**	No statistical data exists because this station has only been sampled for four years. Visual observation shows an increasing (worsening) trend since 2004. Current year trend shows an increase from June to August, and a decrease from August to October.
110	1.25 – 2.70	2.02	0.86 – 3.45	Statistical analysis of historic data shows no overall increase or decrease in the mean annual concentration since monitoring began. Visual observation shows a slightly variable mean annual concentration that has been increasing (worsening since 2003). Current year trend shows an increase from June to September, and a decrease from September to October.

* = 2007 maximum value is the highest maximum value that has been measured at this station since monitoring began.

** = 2007 annual mean is the highest annual mean at this station since monitoring began.

The annual mean chlorophyll-a concentration ranged between **1.29 mg/M³ (Station 020)** and **2.12 mg/m³ (Station 070)** at the nearshore stations during **2007** which is similar to the chlorophyll concentrations measured at the deep spots. Overall, chlorophyll-a concentrations decreased from those measured in 2006.

VIEWSCOPE TRANSPARENCY

Figure 2 and Table 3B:

- The graphs in Figure 2 (Appendix E) show historical and current year data for lake viewscope transparency. Table 3B (Appendix F) lists the maximum, minimum and mean viewscope transparency data for each sampling season that the lake has been monitored through the program.

  Volunteer monitors use the Secchi-disk, a 20 cm disk with alternating black and white quadrants, to measure water clarity (how far a person can see into the water). Viewscope transparency, a measure of water clarity, can be affected by the amount of algae and sediment from erosion, as well as the natural colors of the water. **The median summer viewscope transparency for New Hampshire's lakes and ponds is 3.2 meters.**

Lake Sunapee Nearshore Station Viewscope Transparency Data

Stn.	2007 Range (min – max) (meters)	2007 Mean Value (meters)	Annual Mean Range all years (meters)	Comments
010	6.10 – 8.18	6.70	5.26 – 8.33	Statistical analysis of historic data shows no overall increase or decrease in the mean annual viewscope transparency since monitoring began. Visual observation shows a slightly decreasing (worsening) mean annual viewscope transparency. If worsening continues, this trend will become significantly significant. Current year trend shows a slight decrease from June to July, and an increase from July to October.
020	4.30 - 4.30 (VOB)	4.30*	3.20 – 5.50	No statistical analysis conducted because this station has not been sampled consecutively for 10 years (was not sampled in 1998 or 2002). Visual observation shows a decreasing (worsening) trend. Current year data shows the viewscope transparency remained stable from June to October.
030	7.13 – 9.00	8.13	7.06 – 9.83	Statistical analysis of historic data shows no overall increase or decrease in the mean annual viewscope transparency since monitoring began. Visual observation shows a fluctuating trend that is slightly decreasing (worsening) since 2003. Current year data shows a slight increase from June to July, a decrease from July to August, and an increase from August to October.

Stn.	2007 Range (min – max) (meters)	2007 Mean Value (meters)	Annual Mean Range all years (meters)	Comments
060	3.7 – 4.70 (VOB)	4.13*	3.50 – 8.00	The maximum depth at this station was approximately 4.7 meters, which indicates that this station was sampled in a different (and less deep) sampling location this summer. Statistical analysis of the historic data shows that the mean annual viewscope transparency has decreased (worsened) by approx. 3.3% per year during the sampling period 1989 – 2007; however it appears the deep spot station has moved, rendering this analysis invalid. Current year data shows viewscope transparency decreased from June to July, and increased slightly from July to October.
070	6.50 - 7.50 (VOB)	6.80*	4.82 – 7.50	This station was not sampled for viewscope transparency during 1999; therefore, a formal 10 consecutive year regression analysis could not be conducted. Visual observation shows an improving trend. Current year data shows transparency decreased from June to July, remained stable from July to September, and increased from September to October.
080	2.00 – 2.00 (VOB)	2.0*	1.67* – 5.0	This station was not sampled from 1993 to 2001; therefore, statistical analysis was not performed. Since 2001, the station was likely sampled in a different, and shallower, location. Since 2004, viewscope transparency has remained relatively stable. Current year data shows the transparency remained stable, and was visible on the bottom, from June to September.
090	6.25 – 7.15	6.70	5.89 – 7.30	This station was not sampled for viewscope transparency during 2000, therefore, a formal 10 consecutive year regression analysis could not be conducted. Visual observation showed a slightly fluctuating trend since monitoring began. Current year data shows a decrease from June to August, and a slight increase from August to September.
100.1	6.20 - 7.70 (VOB)	6.98*	6.51 – 7.85	Statistical data does not exist for this station because it has not been monitored for 10 consecutive years. Visual observation showed the viewscope transparency trend to be decreasing (worsening) since monitoring began in 2004. Current year data shows a decrease from June to August, and a gradual increase from August to October.
110	5.25 – 6.75	5.80	5.20 – 8.40	Statistical analysis of historic data showed a variable mean annual viewscope transparency trend since monitoring began. Visual observation showed the viewscope transparency to be decreasing (worsening) since 1990. If this trend continues, the change will become significantly different. Current year data shows a decrease from June to August, stable from August to September, and then an increase from September to October.

VOB = Visible on bottom.
* = Not a true mean because at least one result was Visible on Bottom.

The annual mean viewscope transparency ranged between approximately **2.0 meters (Station 080 - a shallow station as the Secchi Disk was visible on bottom)** and **8.13 meters (Station 030)** during **2007**. Overall, the 2007 mean

transparency increased from 2006 likely due to the overall decrease in chlorophyll-a concentrations and thus the overall decrease in lake productivity.

TOTAL PHOSPHORUS (WATER COLUMN COMPOSITE)

- **Figure 3 and Table 8:** The graphs in Figure 3 (Appendix E) show the amounts of phosphorus historically measured; the inset graphs show current year data. Table 8 (Appendix F) lists the annual maximum, minimum, and median concentration for each deep spot layer and each tributary since the lake has joined the program.

  Phosphorus is the limiting nutrient for plant and algae growth in New Hampshire's freshwater lakes and ponds. Too much phosphorus in a lake can lead to increases in plant and algal growth over time.

Lake Sunapee Nearshore Station Phosphorus Data

Stn.	2007 Range (min – max) (ug/L)	2007 Mean Value (ug/L)	Annual Mean Range for all sampling years (ug/L)	Comments
010	5 – 240*	52.4	1.8 – 52.4**	Statistical analysis of historic data showed no overall increase or decrease in the mean annual concentration since monitoring began. Visual observation showed an increasing (worsening) mean annual concentration. This is due to the elevated 2007 October result. Current year data shows a gradual decrease from June to September, and then a drastic increase from September to October.
020	5 - 13	9.3	1.8 – 15.7	Statistical analysis of historic data showed no overall increase or decrease in the mean annual concentration since monitoring began. Visual observation showed a slightly increasing (worsening) annual concentration. Current year data shows a gradual decrease from June to October.
030	5 - 8	6.6	2.0 – 47.3	Statistical analysis of the historic data showed that the mean annual phosphorus concentration has increased (worsened) by approx. 9.7% per year since 1986. Current year data shows a slight increase from June to July, a decrease from July to August, stable from August to September, and an increase from September to October.
060	7 – 12	9.3	2.0 – 39.3	Statistical analysis of the historic data showed that the mean annual phosphorus concentration has decreased (improved) by approx. 9.9% per year since 1986. However, since 1991, visual observation showed total phosphorus to be relatively stable. Current year data showed total phosphorus to increase from June to July, decrease from July to September, and increase from September to October.
070	5 - 32	13.0	1.0 – 19.0	Statistical analysis of historic data showed the annual mean total phosphorus concentration has increased (worsened) by 8.25% each year since monitoring began in 1986. Current year data showed a steady decrease from June to September and a large increase in October.

Stn.	2006 Range (min – max) (ug/L)	2006 Mean Value (ug/L)	Annual Mean Range for all sampling years (ug/L)	Comments
080	8 – 51*	22.8**	2.8 – 22.8**	Statistic analysis of the historic data showed that the mean annual phosphorus concentration has increased (worsened) by approx. 9.7% per year since 1993; and particularly since 2004. Current year data shows the total phosphorus decreased from June to July, increased from July to August, and drastically increased from August to September. The turbidity of the September sample was elevated suggesting bottom sediment contamination.
090	5 - 8	6.3	1.5 – 25.8	Statistical analysis of the historic data showed that the mean annual phosphorus concentration has not increased or decreased since monitoring began. Visual observation showed a variable trend. Current year data shows total phosphorus decreased gradually from June to September.
100.1	7 - 65	22.0	9 – 34	No statistical data exists at this station because it has not been sampled for 10 consecutive years. Visual observation showed an increasing trend since 2003. Current year data shows an increase from June to September, and a drastic increase from September to October.
110	6 - 10	7.6	1.3 – 11.5	Statistical analysis of the historic data showed that the mean annual phosphorus concentration has increased (worsened) by approx. 3.6% per year since 1988. Current year data showed a gradual decrease from June to August, and a gradual increase from August to October.

* = 2007 maximum value is the highest maximum value measured at this station since monitoring began
** = 2007 annual mean is the highest annual mean at this station since monitoring began

The mean total phosphorus reading at the nearshore stations ranged between **6.3 ug/L** (**station 090**) and **52.4 ug/L** (**station 010**) during **2007**.

The mean annual total phosphorus concentration was ***elevated*** at **Station 010 Station 080,** and **Station 100.1**. Specifically, on the **October 15** sampling event, the phosphorus concentration at **Station 010** was **240 ug/L**; and the phosphorus concentration at **Station 100.1** was **65 ug/L**; however, the turbidity was ***not elevated*** **(1.9 and 2.2 NTUs)** which suggests that soil particles or algal cells did not contribute to the elevated phosphorus concentration. Field observations indicate heavy rainfall 24-72hours prior to sampling. Excessive watershed runoff could have contributed to the elevated phosphorus concentration. Also, the lake was likely turning over potentially mixing phosphorus rich bottom waters throughout the water column.

In addition, the phosphorus concentration was ***elevated*** at **Station 080** on the **August 22, and September 18** sampling events **(28 and 51 ug/L);** and the turbidity was also ***elevated*** **(9.8 and 31.8 NTUs)**. This suggests that the lake

bottom may have been disturbed by the anchor or by the Kemmerer Bottle while sampling and/or that the lake bottom is covered by an easily disturbed thick organic layer of sediment. When the lake bottom is disturbed, phosphorus rich sediment is released into the water column. ***When collecting the integrated sample, make sure that there is no sediment in the tube before filling the sample bottles***.

Statistical analysis of the data shows that the mean annual phosphorus concentration at **Station 030** has ***increased (worsened)*** by approximately **9.7 percent** per year, on average, since monitoring began. Please note that this significant worsening trend was exacerbated by the elevated **2005** annual mean **(47.3 ug/L)** at this station. In **2007**, the annual mean decreased to **6.6 ug/L**.

Statistical analysis of the data shows that the annual mean phosphorus concentration at **Station 060** has ***decreased (improved)*** by **9.9 percent** per year since **1986**. However, it is important to note that this decreasing trend is mostly explained by the elevated phosphorus concentrations measured during **1989** and **1990** at this station. Since **1991**, statistical analysis of the data shows a stable phosphorus concentration at this station.

Statistical analysis of the data shows that the mean annual phosphorus concentration at **Station 080** has ***increased (worsened)*** by approximately **9.7 percent** since **1993**. However, it is important to note that this increasing trend is mostly explained by the exacerbated phosphorus concentration measured since 2005. The shallow depth of this station, and the associated turbidity levels measured in the samples, leads to sediment contamination and likely inaccurate phosphorus results. Please schedule an annual biologist visit to make corrections to sampling methods at this station.

Statistical analysis of the data shows that the mean annual phosphorus concentration at **Station 070** and **Station 110** has ***increased (worsened)*** by approximately **8.25** and **3.6 percent** per year, on average, since monitoring began.

Table 4 : pH

Table 4 (Appendix F) presents the in-lake and tributary current year and historical pH data.

pH is measured on a logarithmic scale of 0 (acidic) to 14 (basic). pH is important to the survival and reproduction of fish and other aquatic life. A pH below 5.5 severely limits the growth and reproduction of fish. A pH between 6.5 and 7.0 is ideal for fish. For a more detailed explanation regarding pH, please refer to the "Chemical Monitoring Parameters" section of this report.

Lake Sunapee Nearshore Station pH Data

Stn.	2007 Range (min – max)	2007 Mean Value (pH value not hydrogen ion content)	Annual Mean Range for all sampling years
010	6.30 - 6.90	6.64	6.14 – 6.92
020	6.31 - 6.60	6.50	6.15 – 6.94
030	6.42 - 6.76	6.59	5.65 – 7.01
060	6.32 - 6.72	6.55	6.20 – 7.10
070	6.25 - 6.55	6.41	6.13 – 6.96
080	6.31 - 6.90	6.59	6.52 – 6.97
090	6.46 - 6.99	6.71	5.86 – 7.00
100.1	6.27 - 6.52	6.44**	6.44** – 6.92
110	6.50 - 6.76	6.62	6.12 – 6.97

** = 2007 annual mean is the lowest annual mean at this station since monitoring began.

The annual mean pH of the nearshore stations ranged from **6.41 (Station 070)** to **6.71 (Station 090)** during **2007**, which indicates that the surface water of the lake is ***slightly acidic***. The mean pH values were similar to the mean pH values for **2006**. The annual mean value at **Station 100.1 (6.44)** was the lowest annual mean since monitoring began. **Overall**, the pH at the nearshore stations continued to be ***satisfactory*** to support aquatic life.

TABLE 6: CONDUCTIVITY

Table 6 (Appendix F) presents the current and historic conductivity values for tributaries and in-lake data. Conductivity is the numerical expression of the ability of water to carry an electric current. For a more detailed explanation, please refer to the "Chemical Monitoring Parameters" section of this report.

Lake Sunapee Nearshore Station Conductivity Data

Stn.	2007 Range (min – max) (uMhos/cm)	2007 Mean Value (uMhos/cm)	Annual Mean Range for all sampling years (uMhos/cm)
010	86.10 - 90.60	87.88	59.6 – 109.2
020	83.20 - 84.60	83.90	60.6 – 105.1
030	82.70 – 86.50	84.68	59.3 – 105.3
060	84.00 - 90.0	87.43	64.8 – 104.0
070	80.40 - 85.10	83.60	59.2 – 103.6
080	82.40 - 85.90	83.95	73.1 – 103.7
090	82.40 - 85.60	83.53	57.9 – 103.98
100.1	82.70* - 85.50*	84.15**	84.15** – 104.3
110	84.90 - 87.50	86.78	56.9 – 109.6

* = 2007 minimum and maximum values are the lowest at this station since monitoring began.
** = 2007 annual mean is the lowest annual mean at this station since monitoring began.

The annual mean conductivity of the nearshore stations ranged between approximately **84.15 uMhos/cm (Station 100.1)** and **87.88 uMhos/cm (Station 010)** during **2007**, which is ***much greater than*** the state median for conductivity in epilimnetic waters **(40.0 uMhos/cm).** Overall, the mean annual conductivity at each nearshore station has ***steadily increased*** since monitoring began. It is important to point out that while the **2005** maximum values at **Stations 010, 030, and 110** were the ***highest*** maximum values that have been measured at each station since monitoring began, mean conductivity values have decreased in **2007** for all stations.

It is likely that the lack of rainfall during the **2007** season reduced watershed runoff to the lake. Typically, rain events and snowmelt cause potentially pollutant laden watershed runoff to reach tributaries and ultimately the lake leading to elevated conductivity levels.

Typically, sources of increased conductivity are due to human activity. These activities include septic systems that fail and leak leachate into the groundwater (and eventually into the tributaries and the lake), agricultural runoff, and road runoff (which typically contains road salt during the spring snow melt). Also, new development in the watershed can alter runoff patterns and expose new soil and bedrock areas, which could contribute to increasing conductivity. In addition, natural sources, such as iron deposits in bedrock, can influence conductivity.

TABLE 11: TURBIDITY

Table 11 (Appendix F) lists the current year and historic data for in-lake and tributary turbidity. Turbidity in the water is caused by suspended matter, such as clay, silt, and algae. Water clarity is strongly influenced by turbidity. Please refer to the "Other Monitoring Parameters" section of this report for a more detailed explanation.

Lake Sunapee Nearshore Station Turbidity Data

Stn.	2007 Range (min – max) (NTUs)	2007 Mean Value (NTUs)	Annual Mean Range for all sampling years (NTUs)
010	0.69 – 2.90	1.70**	0.40 – 1.70**
020	0.79 – 1.65	1.06	0.35 – 1.90
030	0.34 – 1.28	0.83	0.38 – 1.36
060	0.94 – 2.30*	1.69**	0.30 – 1.69**
070	0.55 - 1.30	0.81	0.38 – 1.33
080	3.90 – 31.80*	13.13**	0.44 – 13.13**
090	0.80 – 1.73	1.46	0.38 – 2.02
100.1	1.20 - 2.20	1.84	0.41 – 2.31
110	0.62 – 2.08	1.13	0.37 – 1.48

* = 2007 maximum value is the highest maximum value that has been measured at this station since monitoring began.
** = 2007 annual mean is the highest annual mean at this station since monitoring began

The mean turbidity reading at the nearshore stations ranged between approximately **0.81 NTUs (Station 070)** and **13.13 NTUs (Station 080)**, which is a **wide range**. The state mean for turbidity in epilimnetic waters is approximately **1.0 NTUs**.

Specifically, the turbidity was ***elevated*** at **Station 080** on the **August 22** and the **September 18** sampling events **(9.8 and 31.8 NTUs, respectively)**. The shallow depth of this station, and the associated turbidity levels measured in the samples, leads to sediment contamination and likely inaccurate phosphorus results. Please schedule an annual biologist visit to make corrections to sampling methods at this station.